

**REGISTER OF EXPERTS  
FOR INFORMATION ON  
MECHANICS OF STRUCTURAL FAILURE**

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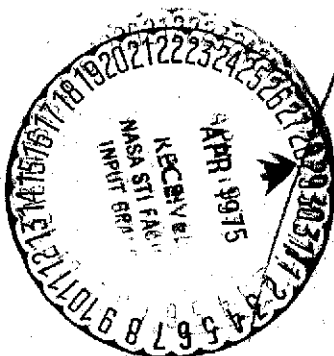
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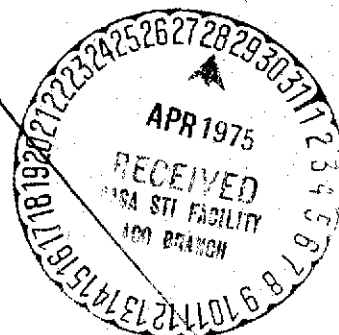
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Orlando, Florida 32805



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George Mandel, Project Manager

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16. Abstract  <p>This Register is comprised of a list of approximately 300 experts from approximately 90 organizations who have published results of theoretical and/or experimental research related to six problem areas in the mechanics of structural failure: (1) Life prediction for structural materials; (2) Fracture toughness testing; (3) Fracture mechanics analysis; (4) Hydrogen embrittlement; (5) Protective coatings; and (6) Composite materials.</p> <p>The criteria for the selection of names for the register are recent contributions to the literature, participation in or support of relevant research programs, and referral by peers. Each author included is listed by organizational affiliation, address, and principal field of expertise.</p> <p>The purpose of the register is to present, in easy reference form, sources for dependable information regarding failure modes and mechanisms of aerospace structures. The register includes two indexes; an alphabetical listing of the experts and an alphabetical listing of the organizations with whom they are affiliated.</p>		
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## FOREWORD

This Register was prepared by Martin Marietta Aerospace under Contract NAS 3-17640. It is one product of a research program initiated by the NASA Lewis Research Center to compile, evaluate, and organize for convenient access information on the mechanics of structural failure and structural materials limitations. The NASA Aerospace Safety Research and Data Institute (ASRDI) has technical responsibility for the research program. Preparation of this report was under the direction of George Mandel, ASRDI Program Manager.

Many people contributed to the preparation of the Register. Their assistance and cooperation is appreciated and gratefully acknowledged. The authors wish to especially acknowledge the interest and assistance of the following individuals in the compilation of the Register: H. Dana Moran, Battelle Memorial Institute; William F. Brown, Jr., John C. Freche, and Gary R. Halford, NASA Lewis Research Center; Daniel C. Drucker and Ross J. Martin, University of Illinois; Walter P. Conrardy, Air Force Materials Laboratory; George R. Irwin, University of Maryland; and George C. Sih, Lehigh University.

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## SUMMARY

This Register is comprised of a list of approximately 300 experts, representing more than 90 different organizations, who have published the results of theoretical and/or experimental research in one or more of six problem areas in the mechanics of structural failure. Each author included is listed by organizational affiliation, address, and principal field of expertise. Multiple listings appear where they seem appropriate.

The criteria for the selection of names for the Register are recent contributions to the literature, participation in or support of relevant research programs, and referral by peers.

The purpose of this publication is to present, in easy reference form, sources for dependable information regarding failure modes and mechanisms of aerospace structures or for other structure subjected to comparable environments. The experts, who are points of contact, could be queried by researchers in similar fields of research and development work for unpublished information and more of the details which have not appeared in published reports, journal articles, or society presentations. In addition, further inquiries could be made regarding active ongoing projects where the published results may not appear for several months. No attempt was made to ascertain that persons listed are actually available for extensive consultation. This is left to negotiation between the parties involved.

The organizational affiliation reflects the latest reference document which was reviewed and is not necessarily current.

Final selection for inclusion was based on the independent judgments of an author's peers as well as the number of his appropriate documents uncovered by a staff of technical reviewers. This is recognized as being an incomplete listing. Nevertheless, we hope that it will be useful as a guide to those who seek related information.

4. Hydrogen embrittlement of superalloys. This subject is of interest regarding turbine buckets, which are exposed to high temperatures. It will be of increasing importance if additional interest develops in using hydrogen as the fuel in gas turbine engines.
5. Protective coatings. Airbreathing engines operating in contaminated environments are in need of protection against attack by the contaminants. Information on the various candidate coatings and the efforts of combustion products of contaminants in jet fuels on engine components is of prime interest. For example, the sulfur ordinarily contained in JP fuels reacts with salt present in shipboard and offshore environments and the resulting compounds attack turbine buckets severely.
6. Composite materials data on low cycle and thermal fatigue. The aim was to search for data related to composite structural materials.

The period of search for published information was June 1962 to April 1974 although earlier publications of classic value were considered. The degree of thoroughness of the search for published experts has been controlled by three factors: (1) the responsiveness of candidate experts; (2) contractual limitations in the form of budget and time; and (3) the priority of the compilation of the Register with respect to other contract tasks.

Under Contract NAS 3-16681 four reports were published: NASA CR-121199, Thesaurus of Terms for Information on Mechanics of Structural Failure; NASA CR-121201, Register of Specialized Sources for Information on the Mechanics of Structural Failure; NASA CR-121200, Register of Experts for Information on the Mechanics of Structural Failure; and NASA CR-121202, Bibliography of Information on the Mechanics of Structural Failure. Under the current contract, NAS 3-17640, the last two of these reports are being updated, revised, and expanded. Much of their revision is directly related to two new tasks under Contract NAS 3-17640. These are the preparation of two technology survey reports, one each in Problem Area No. 1 and No. 2. Because of the particular emphasis in study on those two problem areas the Register is somewhat unbalanced in its listings.

Considerable effort has been made to assure that the persons listed are in fact still working in the fields of interest. Even so it is not possible to guarantee that the expert is available for consultation or that he is at the address shown. Retirees who are still active professionally are listed at their last affiliation unless they indicated a preferred alternate address. Other experts are listed at the organizational affiliation shown in their latest referenced publication unless direct inquiry resulted in a more recent address. In no case have the authors attempted to ascertain that the persons listed are actually available for extensive negotiation. This is left to negotiation between them and other interested parties.

## INTRODUCTION

A prime asset in any research program is the ready availability of resources including people. The NASA Lewis Research Centers Aerospace Safety Research and Data Institute (ASRDI) investigation of the mechanics of structural failure and structural materials limitations has included the task of identifying the most knowledgeable people doing work in the areas under study. To develop a useful list, i.e., one that potentially was comprised of experts available for consultation, an effort has been made to personally contact each individual listed in this Register.

Since June 1972, the Orlando Division of Martin Marietta Aerospace has been ASRDI's agent for the compilation and publication of a Register of Experts for Information on the Mechanics of Structural Failure. An initial issue, NASA CR-121200, was published in June 1973 under NASA Contract NAS 3-16681. The authors searched various directories but found none of significant help. A November 1966 Battelle publication, "Roster of the U.S. Government Metal-working Processes and Equipment Program," was one of the few pertinent documents of value. In the end information had to be obtained through letters of inquiry and personal visits. Throughout the investigation the criteria for being included in the Register has been referral by peers and current publication in areas of interest in the mechanics of structural failure.

The six problem areas of interest in the mechanics of structural failure are:

1. Life prediction of materials exposed to monotonic and cyclic loadings. Initially attention was primarily focused only on low cycle fatigue and thermal fatigue at elevated temperatures (equivalent to those in the hot end of a gas turbine engine) and on high cycle fatigue data for materials used in components such as engine bearings. Subsequently the area of survey was expanded to include consideration of solar cell applications, the effect of cryogenic temperature and vacuum environments, and radiation effects.
2. Fracture toughness data on various structural materials. Available data are categorized with respect to test methods  $K_{Ic}$  vs  $K_C$  and other peculiar parameters considered by the investigators. In particular, data derived from ASTM standard tests are identified.
3. Fracture mechanics analyses - capabilities and limitations. A significant number of publications deal with linear elastic fracture mechanics and assume plane strain. Attempts were made to identify any work that was done, taking into account elastic-plastic theories.

## PROBLEM AREA 1

Life prediction of materials exposed to monotonic and cyclic loading - Experts in the life prediction of materials subject to creep, low-cycle fatigue and thermal fatigue are presented. Particular areas of emphasis include the thermal/mechanical environment of the hot end of the gas turbine engine and the initiation and propagation of fatigue cracks in smooth and precracked specimens. Other areas included are the interactions between creep, fatigue and the environment at elevated temperatures; thermal and mechanical fatigue effects on solar cells in the cryogenic vacuum environment; radiation effects on high temperature mechanical properties; and high cycle fatigue technology as applicable to gas turbine engine bearings.

1-1



Expert

Organization

ABELKIS, Paul R.  
McDonnell Douglas Company  
Long Beach, California

ACHTER, M. R.  
Naval Research Laboratory  
Washington, D. C.

ANDERSON, William J.  
NASA Lewis Research Center  
Cleveland, Ohio

ANSELL, George S.  
Rensselaer Polytechnic Institute  
Troy, New York

AVERY, Donald H.  
Brown University  
Providence, Rhode Island

BERNSTEIN, M. P.  
Foster-Wheeler  
Livingston, New Jersey

BERRY, Warren E.  
Battelle Memorial Institute  
Columbus, Ohio

BIENIEK, Maciej P.  
Columbia University  
New York, New York

BISSON, Edmond E.  
NASA Lewis Research Center  
Cleveland, Ohio

Expertise

Fatigue of materials and structures.  
Fatigue design, analysis and testing.  
Loads spectra. Statistical analysis.  
Structural design. Crack propagation  
and fracture analysis.

Flow and fracture characteristics  
of metals at elevated temperatures.  
Environmental effects on creep and  
fatigue. Refractory metals. Effects  
of laser radiation on materials.

Life prediction of materials exposed  
to cyclic loading in rolling and  
sliding concentrated contacts.  
Rolling fatigue. Contact stresses.  
Elastohydrodynamics. Ball and roller  
bearings. Gears.

Life prediction of materials. High  
temperature properties. Dispersion  
strengthened materials.

Fatigue. Fracture mechanics analysis.  
Superplasticity. Crystal plasticity.  
Mechanical, physical, and powder  
metallurgy.

Life prediction of materials at  
elevated temperatures. Low-cycle  
fatigue.

Life prediction of materials.  
Environmental effects. Elevated  
temperature effects. Crack initiation  
and propagation.

Creep and fatigue failure predictions.  
Inelastic solids. Large deflections  
of structures. Structural dynamics.

Advanced bearing technology. Rolling  
element fatigue life. Lubrication.

Expert

Organization

BLUHM, Joseph I.  
Army Materials & Mechanics  
Research Center  
Watertown, Massachusetts

BOETTNER, R. C.  
United Aircraft Corporation  
East Hartford, Connecticut

BRINKMAN, C. R.  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee

BUCCI, Robert J.  
Alcoa Research Laboratories  
New Kensington, Pennsylvania

BUNTIN, William D.  
General Dynamics Corporation  
Fort Worth, Texas

CAMMETT, John T.  
Metcut Research Associates  
Cincinnati, Ohio

CARDEN, Arnold E.  
University of Alabama  
University, Alabama

Expertise

Fatigue. Dynamic effects. Brittle fracture. Experimental mechanisms. Thin structural shells.

Fatigue. High strain low-cycle fatigue. Crack nucleation. Crack growth. Fatigue crack propagation.

Life prediction of materials. Low-cycle fatigue. High temperature environments. Radiation effects. Stainless steels. Failure predictions. Failure analysis.

Fracture mechanics analysis. Test methods. Structural engineering problems. Fatigue life prediction under constant and variable amplitude loading.

Metal fatigue and fracture mechanics technology. Fatigue and fracture testing including aircraft structural materials and full-scale aircraft structural subsystems.

Fatigue and low-cycle fatigue testing. Fatigue failure of metals. Fracture toughness and fatigue crack propagation testing. Effects of surface integrity and residual stress.

Life prediction of materials at elevated temperature. Fatigue. Fatigue crack growth. Creep crack growth. Fracture toughness-experimental methods. Design of experiments.

Expert

Organization

CARMAN, Carl M.  
Frankford Arsenal  
Philadelphia, Pennsylvania

CHRISTENSEN, Roy H.  
McDonnell Douglas Company  
Huntington Beach, California

COFFIN, Louis F., Jr.  
General Electric Company  
Schenectady, New York

COHEN, Bernie  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

COLES, Anton  
General Electric Company  
Cincinnati, Ohio

CONWAY, Joseph B.  
Mar-Test, Inc.  
Cincinnati, Ohio

COOPER, William E.  
Teledyne  
Waltham, Massachusetts

CORTEN, Herbert T.  
University of Illinois  
Urbana, Illinois

CREAGER, Matthew  
Del West Associates  
Los Angeles, California

Expertise

Low-cycle fatigue. Crack initiation.  
Crack propagation. High strength  
aluminum alloys. Ultra high strength  
steels.

Life prediction of aerospace structures.  
Structural analysis. Structural tests.  
Aircraft structural design.

Low-cycle fatigue. Thermal fatigue.  
Fatigue crack nucleation and propagation.  
High-temperature materials. Fracture  
analysis. Plasticity. Plastic working  
processes. Friction and wear.

Life prediction of materials.  
Metallurgical failure analyses of  
aerospace structural materials.

Fatigue limits. High temperature.  
High strength alloys. Fracture  
analysis methods.

Life prediction techniques for stress  
rupture and low-cycle fatigue. Creep  
and rupture behavior at elevated  
temperature. Creep-fatigue inter-  
action effects.

Life prediction. Fatigue. Structural  
analysis and evaluation. Application  
of material properties to design.  
Pressure vessel and pressure piping  
codes.

Fracture toughness, strength, and  
fatigue of structural composites.  
Crack propagation. Analysis methods.  
Test methods.

Fatigue. Failure predictions.  
Crack propagation. R-Curves. Thin  
metal sheets.

Expert

Organization

CREWS, John H., Jr.  
NASA Langley Research Center  
Hampton, Virginia

CROOKER, Thomas W.  
Naval Research Laboratory  
Washington, D. C.

DAVIS, Andrew W.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

DAVIS, Sidney O.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

DEVEREAUX, Owen F.  
University of Connecticut  
Storrs, Connecticut

DIETRICH, Marshall W.  
NASA Lewis Research Center  
Cleveland, Ohio

DONACHIE, Matthew J., Jr.  
United Aircraft Corporation  
East Hartford, Connecticut

DRUCKER, Daniel C.  
University of Illinois  
Urbana, Illinois

ELLIOTT, Steven Y.  
McDonnell Douglas Company  
Long Beach, California

Expertise

Fatigue. Crack propagation. Stress concentration. Elastoplastic Stress-strain behavior.

Low-cycle fatigue in high strength alloys. Crack propagation in high strength steels. Toughness of welded structures.

Life prediction of composite materials. Structural reliability. Fatigue. Fracture mechanics of composite materials.

Fracture mechanics analysis. Linear elastic concepts. Crack propagation. Aluminum, titanium, and columbium alloys. Fatigue.

Life prediction of amterials exposed to cyclic loading. Environmental dependence. Aluminum.

Rolling element fatigue. Elasto-hydrodynamic lubrication at both cryogenic and high temperatures. Bearing and geraing materials evaluation. Mechanical power transmission system research and devleopment.

Metallurgy of high temperature alloys. Mechanical behavior of metals. X-ray metallurgy. Environmental effects. Electron microscopy. Nickel and cobalt base alloys.

Life prediction. Fracture of metals. Crack behavior. Plasticity. Brittleness. Analysis methods.

Life prediction of metallic, adhesive, bonded, and composite aerospace structures. Structural design and analysis. Testing.

Expert

Organization

FIGGE, I. E.  
Army Air Mobility R&D Laboratory  
Ft. Eustis, Virginia

FINDLEY, William N.  
Brown University  
Providence, Rhode Island

FITZGERALD, John H.  
Northrop Corporation  
Hawthorne, California

FLOREEN, Stephen  
International Nickel Company  
Sterling Forest, New York

FORSBERG, D. Kevin  
Lockheed Aircraft Corporation  
Burbank, California

FRECHE, John C.  
NASA Lewis Research Center  
Cleveland, Ohio

FREUDENTHAL, Alfred M.  
George Washington University  
Washington, D. C.

GALLAGHER, Joseph P.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

GELL, Maurice  
United Aircraft Corporation  
East Hartford, Connecticut

Expertise

Fracture mechanics. Fatigue limits.  
stress. Fatigue tests. Titanium.  
Steel alloys.

Fatigue. Creep. Photoelasticity.  
Viscoelasticity. Fatigue of metals  
in combined stress. Strength  
properties of plastics at various  
temperatures.

Prediction of fatigue crack growth.  
Titanium and aluminum alloys.  
Analysis methods. Fracture mechanics  
testing techniques.

Material properties. High temperature  
metallurgy. Environmental effects.  
Nickel-base alloys. High strength  
steels. Laminar composites.

Fatigue. Aircraft structural design.  
Life testing for aerospace structures.

Fatigue data and life prediction of  
various structural materials. Nickel  
and cobalt base alloys. Materials for  
airbreathing and space propulsion systems.

Life prediction of structures.  
Fatigue of metals and nonmetals.  
Inelastic behavior of engineering  
materials. Plasticity. Structural  
design. Analysis methods.

Corrosion fatigue. Crack propagation.  
Fracture methanics. Structural analysis.

Life prediction of materials at  
elevated temperatures. Loads.  
Deformation and fracture mechanisms.  
Fractography. Fatigue. Creep.  
Superalloys.

Expert

Organization

GERBERICH, William W.  
University of Minnesota  
Minneapolis, Minnesota

GOLDHOFF, Robert M.  
General Electric Company  
Schenectady, New York

HALFORD, Gary R.  
NASA Lewis Research Center  
Cleveland, Ohio

HARDRATH, Herbert F.  
NASA Langley Research Center  
Hampton, Virginia

HARMSWORTH, Clayton L.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

HERTZBERG, Richard W.  
Lehigh University  
Bethlehem, Pennsylvania

HIRSCHBERG, Marvin H.  
NASA Lewis Research Center  
Cleveland, Ohio

HOFER, K. E., Jr.  
IIT Research Institute  
Chicago, Illinois

HOFF, Nicholas J.  
Stanford University  
Stanford, California

Expertise

Fatigue. Fracture mechanics.  
Environmental effects. Hydrogen  
embrittlement.

Life prediction of materials at high  
temperature. Steel alloys. Steam  
turbine generator applications. High  
temperature creep.

Life estimation of materials exposed  
to cyclic loading at high temperature.  
Creep. Low-cycle fatigue. High  
temperature alloys.

Fatigue life prediction of aerospace  
structures and materials. Complex  
loadings. Complex configurations  
Plasticity effects. Elevated temperature  
effects. Environmental effects. Fracture  
mechanics analysis.

Mechanical properties of metals and  
alloys. Fatigue. Testing. Fracture  
mechanics analysis.

Deformation and fracture of materials.  
Fatigue crack propagation of metals  
and polymers. Failure analysis.  
Mechanical response of unidirectional,  
solidified, eutectic composites.

Low-cycle fatigue. Life prediction of  
structural materials. Notch effects.  
Creep-fatigue. Fracture toughness.

Fatigue mechanisms. Creep properties.  
Glass reinforced plastics for aircraft  
structures.

Life prediction of structural materials.  
Fatigue. Creep. Crack propagation.

Expert

Organization

HOWES, Maurice A. H.  
IIT Research Institute  
Chicago, Illinois

HYLER, Walter S.  
Battelle Memorial Institute  
Columbus, Ohio

ILLG, Walter H.  
NASA Langley Research Center  
Hampton, Virginia

JASKE, Carl E.  
Battelle Memorial Institute  
Columbus, Ohio

JOHNSON, R. E.  
General Electric Company  
Cincinnati, Ohio

KOENIG, Herbert A.  
University of Connecticut  
Storrs, Connecticut

KREMPL, Erhard  
Rensselaer Polytechnic Institute  
Troy, New York

LAIRD, Campbell  
University of Pennsylvania  
Philadelphia, Pennsylvania

Expertise

Thermal fatigue. Contact fatigue in concentrated contact. Lubrication. High temperature corrosion.

Fatigue life prediction of aerospace structures and materials. Elevated temperature and other environmental effects. Application of fracture mechanics analysis in damage tolerant structures.

Fatigue life. Structural steels and titanium alloys at elevated temperatures.

Low-cycle fatigue. Elevated temperature environments. Superalloys. Stainless steels. Stress-strain behavior.

Failure predictions. Elevated temperatures. Crack growth analysis. Brittle fracture. Fracture mechanics analysis.

Life prediction of materials. Fatigue. Elastic-plastic analysis of structures. Creep. Deformation.

Fatigue. Creep. Fracture. Deformation and fracture behavior at elevated temperatures. Gas turbine, steam turbine, and nuclear reactor applications. Constitutive equations to describe time-dependent material behavior.

Fracture of materials. Fatigue. Cyclic stress-strain response of materials. Phase transformations. Morphology, growth kinetics and stability of precipitates. Interfaces. Electron microscopy.

Expert

Organization

LANDGRAF, Ronald W.  
Ford Motor Company  
Dearborn, Michigan

LANGER, B. F.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

LAWTON, C. W.  
Combustion, Engineering  
Windsor, Connecticut

LEVEN, M. M.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

LEVERANT, Gerald R.  
United Aircraft Corporation  
East Hartford, Connecticut

LIPSITT, Harry A.  
Aerospace Research Laboratories  
Wright-Patterson AFB, Ohio

LITTLE, C. Dale  
General Dynamics Corporation  
Fort Worth, Texas

LITTLE, Robert E.  
University of Michigan  
Dearborn, Michigan

Expertise

Fatigue crack initiation and propagation.  
Fatigue analysis methods. Cyclic  
deformation and fracture behavior of  
metals and alloys.

Life prediction of materials. Low-  
cycle fatigue. High temperature.  
Pressure vessels.

Life prediction of structural materials.  
Fatigue. High temperature environments.

Life prediction of materials. Fatigue.  
Creep. Environmental effects.  
Steels.

Life prediction of materials at  
elevated temperatures. Mechanical  
metallurgy. Thermal fatigue. Monotonic/  
cyclic deformation and fracture  
mechanics. Crack initiation and pro-  
pagation. Creep. Fatigue. Superalloys.

Mechanical metallurgy. Fatigue, creep,  
tension, and hardness properties of  
ceramics. Diffusion and strain aging.  
Elasticity. Precipitation hardening.

Fracture mechanics analysis. Test and  
analysis methods for crack propagation  
and residual strength. Application of  
fracture control plans to aircraft  
structures.

Life prediction of structural materials.  
Fatigue. Modes of failure. Reliability  
analysis. Statistical design of  
experiments.



Expert

Organization

McCONNLEE, J. E.  
General Electric Company  
Schenectady, New York

MANJOINE, Michael J.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

MANSON, Samuel S.  
Case Western Reserve University  
Cleveland, Ohio

MERKLE, John G.  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee

MILLER, James R.  
Rockwell-Atomics International  
Northridge, California

MOEN, R. G.  
Nordberg Manufacturing  
Milwaukee, Wisconsin

MORRISON, Thomas W.  
SKF Industries, Inc.  
King of Prussia, Pennsylvania

MORROW, Jo Dean  
University of Illinois  
Urbana, Illinois

MOWBRAY, Donald F.  
General Electric Company  
Schenectady, New York

NELSON, Lloyd  
Lockheed Aircraft Corporation  
Burbank, California

Expertise

Life prediction of materials at elevated temperatures. Low-cycle fatigue. Thermal effects.

Mechanics of materials. Elevated temperature properties. High speed tensile testing. Notch effects. Testing machine design.

Life prediction of materials. Monotonic and cyclic loading. Elasticity. Thermal stress in design. Creep. Fatigue. Vibration. High temperature materials.

Fatigue. Fracture mechanics. Fracture toughness. Environmental effects. Pressure vessels. Nuclear reactors.

High temperature metallurgy. Heat transfer. Radiation effects on materials.

Life prediction of materials. Low-cycle fatigue. High temperature environments.

Rolling element materials at high temperatures. Fatigue. Ball bearings.

Life prediction of materials. Structural fatigue. Laboratory simulation. Steels.

Metal fatigue. Material damping. Brittle fracture of metals. Dynamic thermoelasticity.

Fatigue. Aircraft structural design. Structural analysis. Structural test.

Expert

Organization

O'DONNELL, W. J.  
O'Donnell & Associates  
Pittsburgh, Pennsylvania

PARKER, Richard J.  
NASA Lewis Research Center  
Cleveland, Ohio

PATON, Neil E.  
Rockwell International, Inc.  
Thousand Oaks, California

PERRIN, J. S.  
Battelle Memorial Institute  
Columbus, Ohio

PHILLIPS, Edward P.  
NASA Langley Research Center  
Hampton, Virginia

POLHEMUS, J. F.  
United Aircraft Corporation  
East Hartford, Connecticut

POTTER, John M.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

RANDALL, Pryor W.  
TRW Systems, Inc.  
Palos Verdes, California

RICE, James R.  
Brown University  
Providence, Rhode Island

ROSTOKER, William  
University of Illinois  
Chicago, Illinois

Expertise

Fatigue. Fracture. Elasticity.  
Plasticity. Field Theory. Limit  
analysis. Instability. Solid  
mechanics. Significance of calculated  
stresses.

Rolling element bearing life. Pre-  
diction of fatigue life and other modes  
of failure. Materials. High speeds.  
Lubrication. High temperatures.  
Residual stresses.

Fatigue, ductile failure, fracture  
toughness, effect of microstructure,  
plastic flow.

Low-cycle fatigue. Creep. Elevated  
temperatures. Stress relaxation.  
Steels. Superalloys.

Fatigue at elevated temperatures.  
Fatigue test methods. Titanium alloys.  
Stainless steels.

Thermal fatigue. Creep properties.  
Creep rupture strength. Ductility.  
Fatigue tests. Failure analysis.

Fatigue life prediction under variable  
amplitude loading. Residual stress.  
Structural analysis.

Creep and fatigue of metals.  
Brittle fracture.

Fatigue. Plane strain fracture  
toughness. Crack tip deformation.  
Notch effects. Strain concentrations.  
Analytical methods.

Fracture processes. Brittle fracture.  
Powder metallurgy. Refractory metals.  
Physical metallurgy. Metal processing.

## Expert

### Organization

SANDOR, Bela I.  
University of Wisconsin  
Madison, Wisconsin

SCIBBE, Herbert W.  
NASA Lewis Research Center  
Cleveland, Ohio

SHEFFLER, Keith D.  
United Aircraft Corporation  
Middletown, Connecticut

SINCLAIR, George M.  
University of Illinois  
Urbana, Illinois

SINES, George  
University of California  
Los Angeles, California

SLOT, T.  
Teledyne  
Waltham, Massachusetts

SMITH, Clarence R.  
General Dynamics/Convair  
San Diego, California

SNOW, A. L.  
Westinghouse Advanced Research  
Division  
Madison, Pennsylvania

SPERA, David A.  
NASA Lewis Research Center  
Cleveland, Ohio

## Expertise

Life prediction of materials.  
Low cycle fatigue. Ductility.  
Plasticity. Cumulative damage  
processes.

Rolling element fatigue life.  
Steel bearing materials. Advanced  
bearing technology.

Fatigue. Creep. Fracture behavior  
at high temperature. Refractory  
alloys.

Fatigue of metals. Mechanical properties.  
Heat treatment of metals. Mechanical  
testing apparatus.

Fatigue failure of metals. Thermal  
effects. Effect of residual stresses.  
Fracture of ceramics. Flaws in ceramics.  
Hydrides in titanium. Fracture mechanics  
analysis.

Fatigue. Low-cycle fatigue tests.  
Strain testing procedures. High  
temperature environments. Pressure  
vessels. Steels.

Life testing. Fatigue. Strain theory.  
Aluminum alloys. Fracture toughness  
testing.

Life prediction of materials.  
Low-cycle fatigue. High temperature  
environments.

Low-cycle fatigue. Creep. Thermal  
effects. High temperature alloys.  
Linear creep damage theory.

Expert

Organization

SULLIVAN, C. Patrick  
United Aircraft Corporation  
East Hartford, Connecticut

SWINDMAN, R. W.  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee

THROOP, Joseph F.  
Benet Weapons Laboratory  
Watervliet, New York

TUPPENY, W. H., Jr.  
Combustion Engineering  
Windsor, Connecticut

VER SNYDER, Francis L.  
United Aircraft Corporation  
East Hartford, Connecticut

WEEKS, R. W.  
Argonne National Lab  
Argonne, Illinois

WELLS, Clifford H.  
United Aircraft Corporation  
East Hartford, Connecticut

WETZEL, R. M.  
MTS  
Minneapolis, Minnesota

WILLIAMS, Dell P.  
NASA Ames Research Center  
Moffet Field, California

WILLIAMS, Ronald H.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

Expertise

Low-cycle fatigue. High cycle fatigue. Creep. Fatigue-creep interaction.

Fatigue. Life tests. Fracture mechanisms. High temperature environments. Radiation effects.

Fatigue crack propagation and fracture toughness of high strength steels and metal laminates. Fatigue and fracture in thick-walled cylinders and pressure vessels.

Life prediction of materials. Low-cycle fatigue. High temperature environments.

Theory of alloying. Precipitation processes in alloys. High temperature creep and fracture solidification. High temperature alloy development.

Low-cycle fatigue. Fatigue at elevated temperatures. Stainless steels.

Life prediction of high temperature alloys. Fatigue. Creep. Fracture mechanics.

Fatigue. Life prediction. Notch effects. Test methods.

Fatigue. Environmental effects. Stress corrosion cracking test methods.

Fatigue. Failure analysis of aerospace structural materials.

Expert

Organization

WOOD, Howard A.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

WOOD, W. A.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

WOODFORD, David A.  
General Electric Company  
Schenectady, New York

WUNDT, B. M.  
General Electric Company  
Schenectady, New York

ZAMRICK, Sam Y.  
Pennsylvania State University  
University Park, Pennsylvania

ZARETSKY, Erwin V.  
NASA Lewis Research Center  
Cleveland, Ohio

ZOELLER, Howard A.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

Expertise

Fatigue and fracture in aerospace structures. Crack propagation prediction under variable amplitude loading.

Life prediction of materials. Fatigue. Creep. Fracture mechanics. High temperature environments. Aircraft structures.

High temperature. Mechanical properties. Creep and radiation damage. Strain aging superplasticity. Temper embrittlement. Thermal fatigue. Cavitation erosion.

Life prediction of materials. Low-cycle fatigue. High temperature environment. Aircraft structures. Fracture mechanics.

Fatigue and fracture mechanics. Radiation effects on structural materials.

Rolling element bearings. Machine elements. Elastohydrodynamics. Mechanical power transmission systems. Rolling element fatigue. Lubrication. Gearing.

Fatigue. Metallurgical failure analysis of aerospace structural materials.

## PROBLEM AREA 2

Fracture toughness testing of various structural materials-  
Experts in the field of fracture toughness testing are presented with special attention to the test method for obtaining plane strain fracture toughness data. In addition experts in the developing area of mixed mode, plane stress testing and data analysis are identified.

II-1

Expert

Organization

ADAIR, Atwell Mason  
Aerospace Research Laboratories  
Wright-Patterson AFB, Ohio

ANDERSON, William E.  
Battelle-Northwest  
Richland, Washington

BARSOM, John M.  
United States Steel Corporation  
Monroeville, Pennsylvania

BERRY, Warren E.  
Battelle Memorial Institute  
Columbus, Ohio

BROWN, B. F.  
Naval Research Laboratory  
Washington, D. C.

BROWN, William F., Jr.  
NASA Lewis Research Center  
Cleveland, Ohio

BUBSEY, Raymond T.  
NASA Lewis Research Center  
Cleveland, Ohio

BUCCI, Robert J.  
Alcoa Research Laboratories  
New Kensington, Pennsylvania

BUNTIN, William D.  
General Dynamics Corporation  
Fort Worth, Texas

Expertise

Plastic deformation and brittle fracture of metals. Mechanism of fatigue limits on metals. Fracture mechanics analysis.

Fracture. Creep. Structural integrity analysis. Damage tolerant design. Subcritical crack behavior in various environments. Test methods analysis.

Fracture toughness. Stress corrosion cracking. Corrosion fatigue. Fatigue. Structural reliability. Fracture mechanics analysis.

Life prediction of materials. Environmental effects. Elevated temperature effects. Crack initiation and propagation.

Fracture mechanics. Stress corrosion cracking. Fracture tests. Corrosion tests. Crack propagation. Elasticity. Plasticity.

Plane strain fracture toughness. High strength materials. Fracture toughness testing methods. Fracture mechanics analysis.

Fracture toughness testing. Experimental stress analysis. High temperature environments.

Fracture mechanics. Test methods. Fatigue. Aircraft structural materials.

Metal fatigue and fracture mechanics technology. Fatigue and fracture testing. Aircraft structural materials and structural subsystem.

Expert

Organization

CAMMETT, John T.  
Metcut Research Associates, Inc.  
Cincinnati, Ohio

CAMPBELL, James E.  
Battelle Memorial Institute  
Columbus, Ohio

CARMAN, Carl M.  
Frankford Arsenal  
Philadelphia, Pennsylvania

CARR, Frank L.  
Army Materials & Mechanics  
Research Center  
Watertown, Massachusetts

CLARK, William G., Jr.  
Westinghouse Research Laboratories  
Pittsburgh, Pennsylvania

COOPER, William E.  
Teledyne  
Waltham, Massachusetts

CREAGER, Matthew  
Del West Associates  
Los Angeles, California

CROOKER, Thomas W.  
Naval Research Laboratory  
Washington, D. C.

CROSLEY, P. B.  
Materials Research Laboratories, Inc.  
Glenwood, Illinois

Expertise

Fracture toughness and fatigue crack propagation testing. Fatigue and low-cycle fatigue testing. Fatigue failure of metals. Effects of surface integrity and residual stress.

Fracture toughness data. Hardenability of steels. Deformation of fracture of materials at low and elevated temperatures. Fatigue crack propagation in metals. Fracture analysis. Heat treatment of steels. Hydrogen embrittlement.

Fracture toughness. Crack initiation. Crack propagation. Low-cycle fatigue. Aluminum alloys. High strength steels.

Fracture toughness. Fractography. Failure analysis. Crack propagation.

Fracture mechanics analysis. Fracture toughness and subcritical crack growth testing. Nondestructive inspection. Failure analysis.

Fracture mechanics. Structural analysis. Pressure vessel and pressure piping design codes.

Fracture mechanics. Failure predictions. Fatigue. Crack propagation. Thin metal sheets.

Fracture toughness testing. Crack propagation. Low-cycle fatigue in high temperature alloys.

Plane strain fracture toughness. Fracture mechanics. Crack behavior. Test methods. Analysis methods.



Expert

Organization

DAHLBERG, E. Philip  
Universal Oil Products  
Des Plaines, Illinois

DAMIANO, Victor V.  
Franklin Institute  
Philadelphia, Pennsylvania

DESISTO, Thomas S.  
Army Materials & Mechanics  
Research Center  
Watertown, Massachusetts

DOLAN, Thomas J.  
University of Illinois  
Urbana, Illinois

FEDDERSON, Charles E.  
Battelle Memorial Institute  
Columbus, Ohio

FITZGERALD, John H.  
Northrop Corporation  
Hawthorne, California

FREED, C. N.  
Naval Research Laboratory  
Washington, D. C.

FREUDENTHAL, Alfred M.  
George Washington University  
Washington, D. C.

GERBERICH, William W.  
University of Minnesota  
Minneapolis, Minnesota

Expertise

Fracture toughness testing. Self-stressed specimens. Stress corrosion cracking. Macro-and-micro-fracture topography.

Fatigue. Fracture characteristics. Flow. Beryllium alloys.

Fracture toughness testing data. Fracture mechanics analysis.

Fatigue of structural components. Deformation and fracture of metals. Experimental stress analyses. Analysis of causes of failure. Environmental effects. Accident reconstruction. Design philosophy.

Fracture toughness testing. Fatigue crack propagation. Fracture analysis methods. Aircraft structures.

Fatigue crack growth rate analysis. Fracture toughness testing. R-curves. Delay and retardation studies.

Fracture toughness testing. R-curves. Fracture analysis. Titanium alloys. Aluminum alloys. Sheet steel.

Fracture toughness. Fatigue of metals and nonmetals. Inelastic behavior of engineering materials. Plasticity. Structural design. Life prediction of materials.

Fracture toughness. Fatigue. Environmental effects. Hydrogen embrittlement.

Expert

Organization

GOODE, Robert J.  
Naval Research Laboratory  
Washington, D. C.

GRUFF, James J.  
Rockwell International, Inc.  
Los Angeles, California

GUNDERSON, Allan W.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

HAHN, George T.  
Battelle Memorial Institute  
Columbus, Ohio

HARTBOWER, Carl E.  
U.S. Department of Transportation  
Sacramento, California

HAYDEN, H. Wayne  
Martin Marietta Laboratories  
Baltimore, Maryland

HUDSON, C. Michael  
NASA Langley Research Center  
Hampton, Virginia

Expertise

Fracture. Stress corrosion cracking.  
High strength steels. Titanium  
alloys. NDE. DT testing.

Fatigue testing. Stress corrosion  
effects. Loads. Structural aluminum  
alloys.

Fracture toughness. Test techniques.  
Fracture mechanics properties of metals.  
Fracture control plans.

Fracture toughness of alloys, ceramics,  
and polymers. The micro-mechanisms of  
fracture. Ductile-to-brittle transition  
in metals. Plastic zones of cracks.  
Fracture mechanics of crack extension,  
dynamic propagation, fracture arrest,  
and cyclic crack growth, crack extension  
and dynamic propagation in pipes and  
pressure vessels. Surface coatings.

Fracture toughness testing. Pre-crack  
charpy testing. Explosion bulge testing.  
Subcritical crack growth.

Mechanical properties of metals.  
Deformation. Fracture. Fatigue.  
Superelasticity. Environmental  
embrittlement of metals and composites.  
Powder metallurgy. Fracture mechanics.

Fatigue-crack propagation and fracture  
toughness on various materials. Fatigue  
life in various gas environments.  
Fatigue-crack propagation under various  
amplitude loadings.

## Expert

### Organization

IRWIN, George R.  
University of Maryland  
College Park, Maryland

JUDY, R. W., Jr.  
Naval Research Laboratory  
Washington, D. C.

KAUFMAN, John G.  
Alcoa Research Laboratories  
New Kensington, Pennsylvania

KENDALL, David P.  
Benet Weapons Laboratory  
Watervliet, New York

KENDALL, Ernest G.  
Aerospace Corporation  
El Segundo, California

KLIMA, Stanley J.  
NASA Lewis Research Center  
Cleveland, Ohio

KOBAYASHI, Albert S.  
University of Washington  
Seattle, Washington

KRAFFT, Joseph M.  
Naval Research Laboratory  
Washington, D. C.

## Expertise

Fracture toughness testing. Crack propagation. Stress. Strain. Fatigue testing. Fracture control plans.

Fracture resistance testing of brittle and ductile materials. Structural aluminum and titanium. Stress corrosion cracking. Crack growth and fracture prevention in structural design. NDE. DT testing.

Mechanical properties of aluminum and its alloys. Fracture. Strain. Stress concentration. Cryogenic applications.

Fracture toughness of high strength steels. Yield strength. Strain rate. Loading. Temperature effects.

Fracture toughness of nonmetallic structural materials. Failure modes. High temperature materials.

Fatigue testing. Crack propagation. Stress rupture. Mechanical properties of nickel and cobalt alloys. NDE.

Analytical methods. Fracture mechanics analysis. Photoelastic techniques. Finite element analysis. Energy methods.

Fracture toughness. Plastic flow. Dynamic effects on toughness. Environmental effects on stress corrosion. Fatigue propagation. Penetration ballistics.

Expert

Organization

KUSENBERGER, Felix N.  
Southwest Research Institute  
San Antonio, Texas

LAIRD, Campbell  
University of Pennsylvania  
Philadelphia, Pennsylvania

LANDES, John D.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

LANGE, Eugene A.  
Naval Research Laboratory  
Washington, D. C.

LITTLE, C. Dale  
General Dynamics Corporation  
Fort Worth, Texas

LIU, Hao-Wen  
Syracuse University  
Syracuse, New York

LORENZ, Paul M.  
Martin Marietta Corporation  
Denver, Colorado

Expertise

Metal fatigue. Nondestructive evaluation methods.

Fracture of materials. Fatigue. Superconductivity. Electron microscopy. Cyclic stress-strain response of materials.

Fracture toughness standard test methods. Subcritical crack propagation. Fracture mechanics analysis. Elastic-plastic fracture criterion using J-integral.

Low-cycle fatigue data in terms of crack propagation rates as a function of total strain range and  $\Delta K$ . Fracture mechanics structural analysis and material characterization in the plane strain, elastic-plastic, and the plastic fracture states.

Fracture mechanics analysis. Test and analysis methods for crack propagation and residual strength. Application of fracture control plans to aircraft structures.

Fracture mechanics analysis. Fracture toughness testing. Fatigue. Crack propagation.

Applied fracture mechanics. Fatigue. Plane strain. Hydrogen effects. Thin-walled tanks. Fracture control plans.

## Expert

### Organization

LOW, John R., Jr.  
Carnegie-Mellon University  
Pittsburgh, Pennsylvania

LOWNDES, Holland B., Jr.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

McCABE, Donald E.  
Armco Steel Corporation  
Middletown, Ohio

McEVILY, Arthur J., Jr.  
University of Connecticut  
Storrs, Connecticut

McMAHON, Charles J., Jr.  
University of Pennsylvania  
Philadelphia, Pennsylvania

McMILLAN, J. Corey  
The Boeing Company  
Seattle, Washington

McNITT, Richard P.  
Virginia Polytechnic Institute  
and State University  
Blacksburg, Virginia

MASTERS, Joseph N.  
The Boeing Company  
Seattle, Washington

MERKLE, John G.  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee

MOSTOVOY, Stephen  
Materials Research Laboratories, Inc.  
Glenwood, Illinois

## Expertise

Failure analysis. Effect of micro-structure on fracture toughness. High strength alloys.

Fatigue testing. Fracture in structures. Aerospace applications.

Fracture toughness of high strength sheet materials and low alloy steels. R-curves. Fatigue crack growth. Transition temperature tests. Corrosion cracking.

Fracture. Crack propagation. Crack detection. Fracture toughness data.

Failure analysis. Creep and fatigue at high temperature. Steels, nickel-base alloys, and titanium-base alloys. Embrittlement by impurities. Environmental effects.

Fatigue testing. Fracture propagation. Stress corrosion resistance. Electron fractography.

Fracture toughness data on various structural materials in various modes. Use of notched hollow rounds for getting toughness data. Hydrogen embrittlement.

Fracture toughness properties of aircraft structural materials. Steel alloys. Fatigue testing. Fracture control plans.

Fracture mechanics. Fracture toughness. Pressure vessels. Nuclear reactors.

Plane strain fracture toughness. Test methods. Crack behavior. Embrittlement.

Expert

Organization

MUKHERJEE, Amiya K.  
The Boeing Company  
Seattle, Washington

MUNSE, William H.  
University of Illinois  
Urbana, Illinois

NAUMANN, Eugene C.  
NASA Langley Research Center  
Hampton, Virginia

NEWMAN, James C., Jr.  
NASA Langley Research Center  
Hampton, Virginia

NICHOLAS, Theodore  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

NOVAK, Stephen R.  
U.S. Steel Corporation  
Monroeville, Pennsylvania

ORANGE, Thomas W.  
NASA Lewis Research Center  
Cleveland, Ohio

PACKMAN, Paul F.  
Vanderbilt University  
Nashville, Tennessee

PARIS, Paul C.  
Brown University  
Providence, Rhode Island

Expertise

Fracture toughness testing. Fatigue limits. Aircraft structures.

Fatigue crack propagation in weldments. Brittle fracture. Fracture mechanics of weldments.

Fatigue tests. Failure mode. Loads. Cycling.

Fracture mechanics analysis. Fracture toughness testing methods. Crack propagation. Elasticity. Elastic-plastic analysis. Analysis methods.

High strain rate loading/testing. Fatigue limits. Aircraft structures.

Fracture toughness. Stress corrosion cracking. Plastic strain. Fracture mechanics. R-curve behavior. High strength steels.

Fracture toughness of aluminum. Crack propagation. Crack growth at cryogenic temperatures. Fracture mechanics analysis.

Fracture toughness testing. Fracture mechanics. NDE.

Fracture toughness and applied mechanics. Structural stability. Plastic analysis of structures. Fracture mechanics analysis. Analysis methods. Fracture control plans.

Expert

Organization

PARKER, Earl R.  
University of California  
Berkeley, California

PELLINI, William S.  
Naval Research Laboratory  
Washington, D. C.

PELLISSIER, George E.  
RRC International, Inc.  
Troy, New York

PETRAK, Gerald J.  
University of Dayton Research  
Institute  
Dayton, Ohio

POPP, Herbert G.  
General Electric Company  
Cincinnati, Ohio

PUZAK, P. P.  
Naval Research Laboratory  
Washington, D. C.

RATWANI, Mohan M.  
Northrop Corporation  
Hawthorne, California

RAYMOND, Louis  
Aerospace Corporation  
El Segundo, California

Expertise

Fracture toughness testing. Micro-  
structures. Fracture control. High  
strength steels.

Metals processing. Brittle fracture.  
Transformation and properties of steel.  
Solidification of metals. Gases in  
metals. Weldability. High temperature  
materials. NDE. DT testing.

Fracture toughness test methods.  
Fracture characteristics of high-  
strength steels. Micromechanisms of  
fracture. Fractography. Effects of  
microstructure on crack resistance and  
fracture toughness. Failure analysis.

Fracture mechanics, fatigue crack  
growth and retardation, stress corrosion  
cracking, test techniques and criterion.

Fracture toughness testing. High  
strength alloys. High temperature.  
Fatigue limits.

Fracture toughness testing. Yield  
strength. NDE. DT testing.  
Environmental effects. Structural  
steels.

Fracture toughness. Fatigue crack  
propagation. Elastic-plastic analyses  
of crack problems. Fracture mechanics  
analyses by mathematical and finite  
element methods.

Fracture. Strengthening mechanisms.  
Recovery of creep resistant substructure.  
Refractory metal processing.

Expert

Organization

RIPLING, Edward J.  
Materials Research Laboratories, Inc.  
Glenwood, Illinois

ROSENFELD, Alan R.  
Battelle Memorial Institute  
Columbus, Ohio

SANDOR, Bela I.  
University of Wisconsin  
Madison, Wisconsin

SHOEMAKER, A. Kent  
United States Steel Corporation  
Research Laboratory  
Monroeville, Pennsylvania

SIH, George C.  
Lehigh University  
Bethlehem, Pennsylvania

SMITH, Clarence R.  
General Dynamics/Convair  
San Diego, California

SMITH, S. H.  
Battelle Memorial Institute  
Columbus, Ohio

SRRAWLEY, John E.  
NASA Lewis Research Center  
Cleveland, Ohio

Expertise

Fracture toughness testing. Crack growth analysis. Plane strain. Brittle fracture.

Fracture of metals, polymers, rocks, and ceramics. Rapid crack propagation and crack arrest. Microstructural origins of fracture toughness and of strength. Mixed mode crack growth. Crack tip plasticity.

Fracture mechanics. Low-cycle fatigue. Plasticity. Ductility. Cumulative damage processes.

Plane strain fracture toughness. Crack initiation. Crack propagation. Notch effects. Low temperature environments. Structural steels. Line piping.

Fracture toughness data analysis on plane strain, plane stress and three-dimensional crack specimens for metals and composites. Mixed mode fracture in the plane and through the thickness. Nonlinear behavior of materials with cracks. Design of test specimens.

Fracture toughness. Strain theory. Fatigue. Aluminum alloys. Life testing.

Fatigue testing. Crack propagation in aluminum alloys. Aircraft structures. Fracture mechanics.

Fracture toughness testing of various structural materials. Fatigue. Plane strain. Fracture mechanics analysis.



Expert

Organization

STEIGERWALD, Edward A.  
TRW, Inc.  
Cleveland, Ohio

SULLIVAN, Ann M.  
Naval Research Laboratory  
Washington, D. C.

TAGGART, Raymond  
University of Washington  
Seattle, Washington

THROOP, Joseph F.  
Benet Weapons Laboratory  
Watervliet, New York

TIFFANY, Charles F.  
Aeronautical Systems Division  
Wright-Patterson AFB, Ohio

TUPPER, Nathan G.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

UNDERSOOD, John H.  
Benet Weapons Laboratory  
Watervliet, New York

WALKER, E. Kenneth  
Lockheed Aircraft Corporation  
Burbank, California

WEISS, Volker  
Syracuse University  
Syracuse, New York

WELLS, Clifford H.  
United Aircraft Corporation  
East Hartford, Connecticut

Expertise

Fracture toughness of high strength materials. Alloys. Plane strain. Hydrogen embrittlement.

Fracture toughness testing. Failure analysis. R-curves. Aluminum alloys. Sheet steels.

Fatigue of metals with respect to crack propagation. Microstructures. Mechanical properties of binary alloys.

Fatigue crack propagation and fracture toughness of high strength steels and metal laminates. Fatigue and fracture in thick-walled cylinders and pressure vessels.

Fracture toughness testing. Crack propagation. Pressure vessels. Fracture mechanics analysis.

Fracture mechanics. Fatigue testing. Fracture propagation. Fracture toughness testing. Aircraft structures.

Fracture toughness testing. Fracture mechanics.

Fracture mechanics. Fatigue. Crack initiation. Crack propagation. Biaxial stress fatigue. Aircraft structures. Fracture control plans.

Fracture toughness testing. Theory of fracture. Fatigue. Residual stress. Fracture mechanics analysis.

Fracture toughness data on various structural materials. Fatigue. Life prediction of high temperature alloys.

Expert

Organization

WESSEL, Edward T.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

WILHELM, David P.  
Northrop Corporation  
Hawthorne, California

WOOD, Howard A.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

ZACKAY, Victor F.  
University of California  
Berkeley, California

ZINKHAM, R. F.  
Reynolds Metals Company  
Richmond, Virginia

Expertise

Crack initiation, propagation, and fracture. Fracture mechanics technology development. Elastic-plastic fracture mechanics. Failure analyses. Structural reliability. Fracture control plans.

Fracture mechanics analysis. Failure criteria. Plane stress fracture. Fracture toughness testing. Fatigue crack growth.

Crack propagation prediction under variable loading. Fracture control plans.

Fracture mechanisms. Environmental effects. Analysis methods. Test methods. Ultra-high strength metals. Ceramics. Protective coatings.

Fracture toughness testing methods. Plane strain and plane stress fracture. Fatigue and fatigue crack propagation testing. Mechanical properties of aluminum.

### PROBLEM AREA 3

Fracture mechanics analysis - Experts are identified in the field of analysis of failure by fracture mechanics techniques. Particular emphasis is placed on those who are active in the development of elastic-plastic theories.

III - 1

Expert

Organization

ABELKIS, Paul R.  
McDonnell Douglas Company  
Long Beach, California

ADAIR, Atwell Mason  
Aerospace Research Laboratories  
Wright-Patterson AFB, Ohio

AMATEAU, Maurice F.  
Aerospace Corporation  
El Segundo, California

ANDERSON, William E.  
Battelle - Northwest  
Richland, Washington

ANTOLOVICH, Stephen D.  
University of Cincinnati  
Cincinnati, Ohio

ARGON, Ali S.  
Massachusetts Institute of  
Technology  
Cambridge, Massachusetts

AVERY, Donald H.  
Brown University  
Providence, Rhode Island

BACKOFEN, Walter A.  
Massachusetts Institute of  
Technology  
Cambridge, Massachusetts

Expertise

Fatigue of materials and structures.  
Fatigue design, analysis and testing.  
Loads spectra. Statistical analysis.  
Structural design. Crack propagation  
and fracture analysis. Analysis methods.

Fracture mechanics analysis. Plastic  
deformation and brittle fracture of  
materials. Mechanism of fatigue limit  
on metals. Fracture toughness testing.

Fracture mechanics analysis. Plastic  
strain anisotropy. Titanium. Crack growth  
rate testing. Analysis methods.

Fracture. Creep. Structural integrity  
analysis. Damage tolerant design.  
Subcritical crack behavior in various  
environments. Test methods analysis.

Fracture mechanics analysis. Fatigue  
crack propagation in metals. Fatigue  
testing. Development of high fracture  
toughness in high strength metals.  
Fracture toughness testing.

Mechanical behavior of materials.  
Physical mechanisms of deformation.  
Physical mechanisms of fracture.  
Fracture mechanics analysis.

Fracture mechanics analysis. Fatigue.  
Superplasticity. Crystal plasticity.  
Mechanical, physical, and powder  
metallurgy.

Metal plasticity. Deformation textures.  
Mechanical anisotropy. High temperature  
deformation. Plastic working processes.  
Fracture. Fatigue. Analysis methods.

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## Expert

### Organization

BARSOM, John M.  
United States Steel Corporation  
Research Laboratory  
Monroeville, Pennsylvania

BEACHEM, Cedric D.  
Naval Research Laboratory  
Washington, D. C.

BECK, Franklin H.  
Ohio State University  
Columbus, Ohio

BEGLEY, James A.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

BLUHM, Joseph I.  
Army Materials & Mechanics  
Research Center  
Watertown, Massachusetts

BROCKRATH, George E.  
McDonnell Douglas Company  
Huntington Beach, California

BROWN, B. F.  
Naval Research Laboratory  
Washington, D. C.

BROWN, William F., Jr.  
NASA Lewis Research Center  
Cleveland, Ohio

BUCCI, Robert J.  
Alcoa Research Laboratories  
New Kensington, Pennsylvania

## Expertise

Fracture mechanics analysis. Fatigue. Corrosion fatigue. Stress corrosion cracking. Fracture toughness. Structural reliability.

Fracture mechanics analyses. Electron fractography. Specimen design. Crack tip mechanisms. Fatigue. Stress corrosion cracking. Hydrogen assisted cracking. Elastic-plastic fracture. Hydrogen embrittlement.

Corrosion mechanics. Effects of metallurgy of materials on corrosion. Analysis methods.

Fracture mechanics analysis. Elastic-plastic fracture concepts and criteria. Crack growth resistance. R-curve techniques.

Fracture mechanics analysis. Fatigue. Brittle fracture. Experimental mechanisms. Dynamic effects.

Ductile fracture theory in metals. Fatigue analysis. Maraging and stainless steels. Aluminum, titanium, and beryllium alloys.

Analytical methods. Stress corrosion cracking. Fracture tests. Corrosion tests. Elasticity. Plasticity.

Thin section mode testing. Plane strain fracture toughness. Fracture toughness testing.

Fracture mechanics analysis. Test methods. Structural engineering problems. Fatigue life prediction under constant and variable amplitude loading.

## Expert

### Organization

BUCK, Otto  
Rockwell International, Inc.  
Thousand Oaks, California

BUDIANSKY, Bernard  
Harvard University  
Cambridge, Massachusetts

CARLSON, Robert G.  
General Electric Company  
Cincinnati, Ohio

CARR, Frank L.  
Army Materials & Mechanics  
Research Center  
Watertown, Massachusetts

CHEN, Yu  
Rutgers University  
New Brunswick, New Jersey

CLARK, William G., Jr.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

CORTON, Herbert T.  
University of Illinois  
Urbana, Illinois

CROSLEY, P. B.  
Materials Research Laboratories, Inc.  
Glenwood, Illinois

DANIEL, Isaac M.  
IIT Research Institute  
Chicago, Illinois

## Expertise

Plasticity of metals. Dislocation theory. Non-linear theory of elasticity. Internal friction. Point-defect migration.

Elastic stability. Aeroelasticity. Plasticity. Vibration. Shell theory. Structural mechanisms.

Composite material fracture phenomena. Model test specimen configurations. Fracture behavior under impact loadings.

Fractography. Fracture toughness. Failure analysis. Crack propagation. Analysis methods.

Fracture mechanics analysis. Vibration. Dynamic stress concentration. Structural analysis.

Fracture mechanics analysis. Fracture toughness and subcritical crack growth testing. NDE.

Fracture mechanics analysis. Test methods. Crack propagation. Fracture toughness, strength and fatigue of composites.

Fracture mechanics. Failure analysis. Test methods. Fracture toughness. Crack behavior. Analysis methods.

Experimental stress and fracture analysis. Strain distribution. Static and dynamic stress concentration. Wave and fracture propagation. Dynamic strength of brittle materials. Composites.

Expert

Organization

DAVIS, Sidney O.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

DESISTO, Thomas S.  
Army Materials & Mechanics  
Research Center  
Watertown, Massachusetts

DONACHIE, Matthew J., Jr.  
United Aircraft Corporation  
East Hartford, Connecticut

DRUCKER, Daniel C.  
University of Illinois  
Urbana, Illinois

ENGLE, Robert M.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

FEDDERSON, Charles E.  
Battelle Memorial Institute  
Columbus, Ohio

FUCHS, Henry O.  
Stanford University  
Stanford, California

Expertise

Fracture mechanics analysis. Linear elastic concepts. Crack propagation. Aluminum, titanium, and columbium alloys. Analysis methods.

Fracture mechanics analysis, Fracture toughness testing. Titanium alloys. Analysis methods.

Mechanical behavior of metals. X-ray metallurgy. High temperature alloys. Environmental effects. Electron microscopy. Analysis methods.

Fracture mechanics. Fracture of metals. Crack behavior. Plasticity. Brittleness. Analysis methods.

Crack propagation prediction methods. Structural analysis. Thermal analysis.

Fracture mechanics. Fatigue crack propagation. Analysis methods. Fracture toughness testing.

Failure criteria for crack initiation and propagation. Residual stress effects. Analysis of irregular load sequences. Analysis methods.

Expert

Organization

GALLAGHER, Joseph P.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

GLASSCO, J. B.  
McDonnell Douglas Company  
Huntington Beach, California

GOODE, Robert J.  
Naval Research Laboratory  
Washington, D. C.

GRANT, Nicholas, J.  
Massachusetts Institute  
Technology  
Cambridge, Massachusetts

GROSS, Bernard  
NASA Lewis Research Center  
Cleveland, Ohio

GROSSKREUTZ, Joseph C.  
Black and Veatch  
Kansas City, Missouri

HARDRATH, Herbert F.  
NASA Langley Research Center  
Hampton, Virginia

HARTBOWER, Carl E.  
Department of Transportation  
Sacramento, California

Expertise

Fracture mechanics. Structural analysis.  
Corrosion fatigue. Crack propagation  
under aircraft service loadings.

Fracture theory. Fatigue analysis  
Aluminum, titanium, and beryllium  
alloys.

Fatigue analysis. Stress corrosion  
cracking. High strength steels.  
Titanium alloys. NDE. DT testing.

Fracture mechanics analysis  
Deformation. Strain rate. Thermal  
effects. Analysis methods.

Fracture mechanics analysis. Stress  
intensity factors. Splitting forces.  
Boundary collocation.

Fracture mechanics analysis. Plastic  
deformation. Metal fatigue. Metal  
physics. Structure of light nuclei.

Non  $K_{Ic}$  toughness, plasticity effects.  
Complex structural configurations.  
Elevated temperature effects. Fatigue  
crack propagation. Stress corrosion  
cracking. Life prediction.

Fracture mechanics analysis. Failure  
analysis of rocket motor cases. Fracture  
toughness testing. Testing weld deposits.  
Precrack Charpy testing. Subcritical  
crack growth. Analysis methods.



Expert

Organization

HILTON, Peter D.  
Lehigh University  
Bethlehem, Pennsylvania

HOEPPNER, David W.  
University of Missouri  
Columbia, Missouri

HULBERT, Lewis E.  
Battelle Memorial Institute  
Columbus, Ohio

HUTCHINSON, John W.  
Harvard University  
Cambridge, Massachusetts

IRWIN, George R.  
University of Maryland  
College Park, Maryland

JACOBSON, Marcus J.  
Northrop Corporation  
Hawthorne, California

JAMES, Lee A.  
Westinghouse Hanford Company  
Richland, Washington

JOHNSON, Herbert H.  
Cornell University  
Ithaca, New York

Expertise

Fracture mechanics analysis, Elastic-plastic analyses.

Fracture mechanics. Fatigue research. Fracture prevention. Aircraft structural design. Fatigue test methods. Kinetics of fatigue crack growth. Crack tip deformation under cyclic loads. Failure analysis. Non-destructive inspection.

Mathematical analysis of fracture in two- and three-dimensional Micromechanics of composites. Thermal stresses and thermal fatigue.

Fracture mechanics analysis. Elastic-plastic analyses.

Fracture mechanics analysis. Stress. Strain. Crack propagation. Fatigue testing. Fracture toughness. Fracture control plans.

Fracture mechanics analysis. Vibration effects. Thermal effects. Composite materials.

Fracture mechanics analyses. Crack propagation in ferritic and austenitic steels and nickel-base alloys at elevated temperatures. Effect of environment on crack propagation.

Deformation of solids. Dislocation mechanics. Physical metallurgy. Fracture mechanics analysis. Hydrogen embrittlement.

Expert

Organization

JUDY, R. W., Jr.  
Naval Research Laboratory  
Washington, D. C.

KIES, Joseph A.  
Naval Research Laboratory  
Washington, D. C.

KOBAYASHI, Albert S.  
University of Washington  
Seattle, Washington

KRAMER, Irwin R.  
Navy Ship R&D Center  
Annapolis, Maryland

KREMPL, Erhard  
Rensselaer Polytechnic Institute  
Troy, New York

KRUPP, William E.  
Lockheed California Company  
Burbank, California

LANDES, John D.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

Expertise

Fracture resistance testing of brittle and ductile materials, structural aluminum and titanium alloys. Stress corrosion cracking testing. Crack growth and fracture prevention in structural design and analysis of service failures. NDE. DT testing.

Fracture mechanics. Failure analysis Methodology. Stress. Strain. Fatigue. Fracture toughness.

Analytical methods. Fracture mechanics analysis. Photoelastic techniques. Finite element analysis. Energy methods.

Plastic deformation. Surface effects related to flow and fracture of metals. Effect of alloying elements on mechanical and physical properties of metals. Hardenability of steels.

Deformation and fracture behavior of materials at elevated temperatures. Creep. Fatigue. Constitutive equations to describe time-dependent material behavior.

Fracture mechanics analysis. Fatigue, fracture, and stress corrosion in aircraft structures. Aircraft alloys. Radiation effects on structural materials.

Elastic-plastic fracture criterion using J-integral. Fracture mechanics analysis. Fracture toughness standard test methods. Subcritical crack propagation.

Expert

Organization

LANGE, Eugene A.  
Naval Research Laboratory  
Washington, D. C.

LEVERANT, Gerald R.  
United Aircraft Corporation  
East Hartford, Connecticut

LI, Che-Yu  
Cornell University  
Ithaca, New York

LIEBOWITZ, Harold  
George Washington University  
Washington, D. C.

LIU, Hao-Wen  
Syracuse University  
Syracuse, New York

MCCARTNEY, Raymond F.  
United States Steel Corporation  
Monroeville, Pennsylvania

LANDGRAF, Ronald W.  
Ford Motor Company  
Dearborn, Michigan

Expertise

Fracture mechanics structural analysis and material characterization in the plane strain, elastic-plastic, and the plastic fracture states. Low-cycle fatigue data in terms of crack propagation rates as a function of total strain range and  $\Delta K$ . Vibration analysis.

Fracture mechanics analysis. Mechanical metallurgy. Thermal fatigue. Crack initiation and propagation. Creep. Fatigue. Superalloys. Life prediction of materials at elevated temperatures.

Fracture mechanics analysis. Sub-critical crack growth. Radiation effects. Surface and interface effects.

Fracture mechanics analysis. Deformation. Plasticity. Crack propagation.

Fracture mechanics analysis. Fracture toughness testing. Fatigue.

Fracture mechanics analysis. Toughness requirements and strain-rate effects. Fatigue crack initiation and propagation. Ductile fracture of gas transmission pipe and softly loaded structures.

Cyclic deformation and fracture behavior of metals and alloys. Fatigue analysis procedures. Fatigue crack initiation and propagation.

## Expert

### Organization

McCLINTOCK, Frank A.  
Massachusetts Institute of  
Technology  
Cambridge, Massachusetts

McGARRY, Frederick  
Massachusetts Institute of  
Technology  
Cambridge, Massachusetts

MENDELSON, Alexander  
NASA Lewis Research Center  
Cleveland, Ohio

MOSTOVOY, Stephen  
Materials Research Laboratories, Inc.  
Glenwood, Illinois

MUNSE, William H.  
University of Illinois  
Urbana, Illinois

NEWMAN, James C., Jr.  
NASA Langley Research Center  
Hampton, Virginia

ORANGE, Thomas W.  
NASA Lewis Research Center  
Cleveland, Ohio

OSIAS, Jonathan R.  
Carnegie-Mellon University  
Pittsburgh, Pennsylvania

PARIS, Paul C.  
Brown University  
Providence, Rhode Island

## Expertise

Fracture mechanics analyses, capabilities and limitations. Plastic flow. Fracture

Fracture mechanics analysis. Mechanisms of fracture of composites. Mechanics of fracture of composites.

Fracture mechanics analysis. Plasticity theory. Deformation. Stress. Strain. Applications theory.

Plane strain fracture toughness. Fracture mechanics. Crack behavior. Test methods. Analysis methods.

Fracture mechanics of weldments. Fatigue. Fatigue crack propagation in weldments. Brittle fracture.

Fracture mechanics analysis. Fracture toughness testing methods. Crack propagation. Elasticity. Elastic-plastic analysis of structures.

Fracture toughness of aluminum. Crack propagation. Crack growth at cryogenic temperatures. Fracture mechanics analysis.

Analysis methods. Numerical analysis. Deformation. Elasto-plastic solids.

Fracture mechanics analyses. Structural stability. Plastic analysis of structures. Fracture toughness. Fracture control plans.

Expert

Organization

RATWANI, Mohan M.  
Northrop Corporation  
Hawthorne, California

RAYMOND, Louis  
Aerospace Corporation  
El Segundo, California

RICE, James R.  
Brown University  
Providence, Rhode Island

RIPLING, Edward J.  
Materials Research Laboratories, Inc.  
Glenwood, Illinois

ROLFE, Stanley T.  
University of Kansas  
Lawrence, Kansas

SIH, George C.  
Lehigh University  
Bethlehem, Pennsylvania

SMITH, C. William  
Virginia Polytechnic Institute  
and State University  
Blacksburg, Virginia

Expertise

Fracture mechanics analyses by mathematical and finite element methods. Elastic-plastic analyses of crack problems. Fracture toughness. Fatigue crack propagation.

Mechanical metallurgy. Thermal mechanical processing. Strengthening mechanisms. Recovery of creep resistant substructure. Refractory metal processing.

Fracture mechanics analysis. Strain concentration. Crack tip deformation. Notch effects. Fracture toughness. R-curves.

Plane strain fracture toughness. Fracture mechanics. Crack behavior. Test methods. Analysis methods.

Applications of linear elastic and general-yielding fracture mechanics. Development of fracture criteria and fracture control plans for structures.

Analytical and numerical analyses of two- and three-dimensional crack problems. Torsion and flexure of bars. Plane extension and bending of plates. Pressurized cylindrical and spherical shells. Surface flaws. Application to structural design.

Fracture mechanics of crack plates in bending including three-dimensional efforts. Elastic-plastic effects. Photoelastic analysis.

Expert

Organization

SMITH, S. H.  
Battelle Memorial Institute  
Columbus, Ohio

SRAWLEY, John E.  
NASA Lewis Research Center  
Cleveland, Ohio

SWEDLOW, Jerold L.  
Carnegie-Mellon University  
Pittsburgh, Pennsylvania

UNDERWOOD, John H.  
Benet Weapons Laboratory  
Watervliet, New York

WEI, Robert P.  
Lehigh University  
Bethlehem, Pennsylvania

WEISS, Volker  
Syracuse University  
Syracuse, New York

WILHEM, David P.  
Northrop Corporation  
Hawthorne, California

WILSON, W. K.  
Westinghouse Electric Corporation  
Pittsburgh, Pennsylvania

WNUK, Michael P.  
South Dakota State University  
Brookings, South Dakota

WOOD, Howard A.  
Air Force Flight Dynamics Laboratory  
Wright-Patterson AFB, Ohio

Expertise

Fracture mechanics analysis. Fatigue testing. Crack propagation in aluminum alloys. Fracture toughness.

Fracture mechanics and analyses. Fatigue. Plane strain. Fracture toughness testing.

Analyses of crack and notch geometries including the effects of elasticity, anisotropy, elastoplasticity, and nonplanar loadings and geometries. Applications to metals and advanced fiber composites.

Fracture mechanics analysis. Crack tip deformation studies. Fracture toughness testing. Composite materials.

Fracture mechanics analysis. Plane strain. Fracture toughness. Test methods.

Theory of fracture. Fatigue. Residual stresses. Solid state phase transformation. X-ray diffraction. Fracture toughness testing.

Fracture mechanics analysis. Failure criteria. Plane stress fracture. Fracture toughness testing. Fatigue crack growth.

Fracture mechanics analysis. Numerical analysis of crack bodies. Plastic and creep analysis of structures.

Mechanics of fracture. Theory of elasticity. Theory of plasticity.

Fracture applications in aerospace structures. Crack propagation prediction under variable amplitude loading.

#### PROBLEM AREA 4

Hydrogen embrittlement of aerospace materials -  
Experts are identified in the area of hydrogen effects on gas turbine engine materials. Special attention is given to those contributing to the understanding of the interactions with superalloys in the high temperature cyclic environment. In addition several experts are presented in the general area of hydrogen embrittlement.

IV-1

Expert

Organization

BEACHEM, Cedric D.  
Naval Research Laboratory  
Washington, D. C.

CAMPBELL, James E.  
Battelle Memorial Institute  
Columbus, Ohio

CATALDO, Eugene  
NASA George C. Marshall  
Space Center  
Huntsville, Alabama

CHANDLER, Willis T.  
Rockwell International, Inc.  
Canoga Park, California

DUQUETTE, David J.  
Rensselaer Polytechnic Institute  
Troy, New York

FRANDSEN, J. D.  
Rockwell International, Inc.  
Thousand Oaks, California

GERBERICH, William W.  
University of Minnesota  
Minneapolis, Minnesota

GIBALA, Ronald  
Case Western Reserve University  
Cleveland, Ohio

Expertise

Hydrogen embrittlement. Test methods.  
Microscopic mechanisms. Stress  
corrosion cracking mechanisms.  
Fracture mechanics analysis.

Hydrogen embrittlement. Hardenability  
of steels. Fatigue of steel and aluminum.  
High strength steels. Fracture toughness.

Hydrogen embrittlement. Steels.  
Stress corrosion cracking mechanisms.

Hydrogen embrittlement. Metallurgy of  
high temperature and refractory alloys.  
Transformations in metals. Liquid  
metal corrosion.

Corrosion science and engineering.  
Effect of environment on mechanical  
properties of crystalline materials.

Hydrogen effects on nickel-based  
alloys. Fracture and fatigue of  
structural alloys.

Hydrogen embrittlement. Fatigue.  
Fracture mechanics. Environmental  
effects.

Hydrogen embrittlement. Internal  
friction. Defects in solder. Acoustics.  
Physical metallurgy.

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Expert

Organization

GRAY, Hugh R.  
NASA Lewis Research Center  
Cleveland, Ohio

Hayden, H. Wayne  
Martin Marietta Laboratories  
Baltimore, Maryland

HEHEMANN, Robert F.  
Case Western Reserve University  
Cleveland, Ohio

HILBERT, Lewis E.  
Battelle Memorial Institute  
Columbus, Ohio

JOHNSON, Herbert H.  
Cornell University  
Ithaca, New York

McCABE, Donald E.  
Armco Steel Corporation  
Middletown, Ohio

Expertise

Hydrogen embrittlement. Hot salt stress corrosion. Titanium alloys.

Mechanical properties of metals. Deformation. Fracture. Fatigue. Superelasticity. Environmental embrittlement of metals and composites. Powder metallurgy. Fracture toughness.

Hydrogen embrittlement. Phase transformations in metals. Relation of structure and properties.

Hydrogen embrittlement. Fracture resistance. Oxidation resistance. Protection of superalloys, refractory metals, and titanium alloys.

Hydrogen embrittlement. Deformation of solids. Dislocation mechanics. Physical metallurgy. Fracture mechanics analysis.

Hydrogen embrittlement. R-curves. Fatigue crack growth. Corrosion cracking. Transition temperature tests. Fracture toughness low alloy steels.

Expert

Organization

McNITT, Richard P.  
Virginia Polytechnic Institute  
and State Univeristy  
Blacksburg, Virginia

MARCUS, Harris L.  
Rockwell International  
Thousand Oaks, California

MOSTOVOY, Stephen  
Material Research Laboratories, Inc.  
Glenwood, Illinois

NELSON, Howard G.  
NASA Ames Research Center  
Moffet Field, California

PATON, Neil E.  
Rockwell International, Inc.  
Thousand Oaks, California

PUGH, N. Neville  
University of Illinois  
Urbana, Illinois

STAEHLE, Roger W.  
Ohio State University  
Columbus, Ohio

STEIGERWALD, Edward A.  
TRW, Inc.  
Cleveland, Ohio

Expertise

Hydrogen embrittlement. Fracture toughness data on structural materials.

Fracture and fatigue of structural alloys. Effect of metallurgical variables and environment. Precipitation studies. Aluminum, titanium, nickel and ferrous alloys. Effect of hydrogen on nickel-based alloys.

Hydrogen effects. Embrittlement. Crack behavior. Plane strain fracture toughness.

Hydrogen embrittlement. Fracture mechanics.

Fatigue, ductile failure, fracture toughness, effect of microstructure, plastic flow. Hydrogen effects.

Hydrogen embrittlement in solids. Stress corrosion cracking and crack propagation in alloys. Diffusion of hydrogen in metals and alloys. Trapping of hydrogen by defects and impurity elements.

Fracture mechanics analysis. Stress corrosion cracking. Corrosion of metals. Corrosion fatigue. Surface chemistry.

Hydrogen embrittlement. Plane strain. Alloys. Fracture toughness testing.

Expert

Organization

TETELMAN, Alan S.  
University of California  
Los Angeles, California

THOMPSON, Anthony W.  
Rockwell International, Inc.  
Thousand Oaks, California

TROIANO, A. R.  
Case Western Reserve University  
Cleveland, Ohio

UHLIG, Herbert H.  
Massachusetts Institute of  
Technology  
Cambridge, Massachusetts

WEI, Robert P.  
Lehigh University  
Bethlehem, Pennsylvania

WERT, Charles A.  
University of Illinois  
Urbana, Illinois

WESTWOOD, A. R. C.  
Martin Marietta Laboratories  
Baltimore, Maryland

WILLIAMS, Dean N.  
Battelle Memorial Institute  
Columbus, Ohio

WILLIAMS, Dell P.  
NASA Ames Research Center  
Moffet Field, California

Expertise

Hydrogen embrittlement. Titanium alloys.

Hydrogen embrittlement of super-alloys and stainless steels. Effect of hydrogen on ductile fracture. Influence of microstructure on hydrogen embrittlement.

Hydrogen embrittlement. Environmental effects. Superalloys. High pressure environment.

Corrosion fatigue. Stress corrosion cracking for steels. Hydrogen cracking of steels.

Fracture mechanics analysis. Test methods. Fracture toughness. Embrittlement.

Diffusion of hydrogen in metals and alloys. Phase diagrams of hydrogen with structural materials. Isotope effects. Precipitation of hydrides. Internal friction.

Embrittlement. Surface effects. Environmental effects. Fracture mechanics. Refractory metals.

Hydrogen embrittlement. Titanium alloys.

Fatigue. Environmental effects. Embrittlement. Stress corrosion cracking test methods.

#### PROBLEM AREA 5

Protective coatings - Contributing experts to the field of protective coatings for components of gas turbine aircraft engines are identified. In addition, those concerned with the behavior in the presence of sulfur and salt resulting from JP fuels and marine environments are listed.

Y-1

Expert

Organization

BESSEN, I. I.  
General Electric Company  
Cincinnati, Ohio

BROWN, Sherman D.  
University of Illinois  
Urbana, Illinois

DEVEREUX, Own F.  
University of Connecticut  
Storrs, Connecticut

DUQUETTE, David J.  
Rensselaer Polytechnic Institute  
Troy, New York

GOWARD, G. W.  
United Aircraft Corporation  
East Hartford, Connecticut

GREEN, John A. S.  
Martin Marietta Laboratories  
Baltimore, Maryland

GRISAFFE, Salvatore J.  
NASA Lewis Research Center  
Cleveland, Ohio

Expertise

Protective coatings. Corrosive effects. Gas turbine engine environments.

Protective coatings. Metals in high temperature environments. Corrosive effects. Erosion.

Protective coatings. Oxidation. Transport in oxide films. Defect structure. Alumina. Silica.

Effects of environment on mechanical properties of crystalline materials. Corrosion science and engineering. Coatings.

Protective coatings. Corrosion science. Gas turbine engine applications.

Protective coatings. Stress corrosion cracking of aluminum and titanium alloys. Aqueous corrosion of aluminum and titanium alloys. Formulation and characterization of aluminum and titanium alloys.

Nickel aluminide coatings. Protective coatings for superalloys.

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Expert

Organization

JAFFEE, Robert I.  
Battelle Memorial Institute  
Columbus, Ohio

KAELBLE, David H.  
Rockwell International, Inc..  
Thousand Oaks, California

NEJEDLIK, James F.  
TRW, Inc.  
Cleveland, Ohio

PERKINS, Roger A.  
Lockheed Missiles and Space Co.  
Palo Alto, California

QUIGG, Harold T.  
Phillips Petroleum Company  
Bartlesville, Ohio

STETSON, Alvin R.  
Solar  
San Diego, California

WURST, John C.  
University of Dayton  
Dayton, Ohio

ZACKAY, Victor F.  
University of California

Expertise

Protective coatings. Oxidation and hot corrosion resistance. Protection of superalloys, refractory metals, and titanium alloys.

Protective coatings. Adhesion phenomena including surface chemistry, rheology, and fracture mechanics. Composite material properties.

Aluminate coatings. Stress corrosion. Coatings for nickel-and cobalt-base alloys. Test methods.

Protective coatings for superalloys. Oxidation protection for hypersonic structures.

Hot corrosion effects. Sulfidation. Superalloys.

Protective coatings for tantalum-based and columbium-based alloys. Turbine engine materials.

Protective coatings for high temperature materials. Aerospace applications. Refractory materials. Thermal fatigue. Test methods.

Protective coatings. Fracture mechanisms. Cryogenic room and elevated temperature testing. Ultra high strength metals.

## PROBLEM AREA 6

Fracture of composite materials - Experts are included from two areas of composite technology: first, the experimental testing and analysis of metal matrix composites, particularly fracture toughness and low-cycle fatigue testing at mildly elevated temperatures and; second, conceptual analysis of nonisotropic materials, particularly in the presence of notches.

VI-1

Expert

Organization

ADSIT, Norman R.  
General Dynamics Corporation  
San Diego, California

BORTZ, Seymour A.  
IIT Research Institute  
Chicago, Illinois

BROUTMAN, Lawrence J.  
Illinois Institute of Technology  
Chicago, Illinois

CARLSON, Robert G.  
General Electric Company  
Cincinnati, Ohio

CHAMIS, Christos C.  
NASA Lewis Research Center  
Cleveland, Ohio

CHIAO, T. T.  
Lawrence Livermore Laboratories  
Livermore, California

CORTEN, Herbert T.  
University of Illinois  
Urbana, Illinois

Expertise

Fiber reinforced composites. Creep.  
Low cycle and high cycle fatigue.  
Tensile, compression, and shear tests.  
Test methodology.

Measurement and analysis of mechanical properties of brittle materials, including ceramic composites, and laminates, graphite materials, ceramic fibers, and refractory carbides. High temperature testing. Mechanical testing for composites.

Fracture toughness, strength, and fatigue of fiber and particulate composites. Effect of material parameters on fracture and fatigue. Crack propagation and fracture in polymers and glasses. Impact strength and damage in polymers and composites. Fracture at interfaces.

Effects of thermal cycling on B/Al fatigue properties. Material, processing and design factors as they relate to B/Al structural properties.

Fiber reinforced composites. Impact resistance. Fracture mechanics. Failure criteria. Composite structural analysis.

Fiber reinforced composites. Stress rupture. Yield strength. Pressure vessels. Filament winding. Ultrasonic analysis.

Fracture toughness, strength, and fatigue of composites. Test methodology. Life prediction of materials exposed to monotonic and cyclic loading at various temperatures.

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Expert

Organization

DALLY, James W.  
University of Maryland  
College Park, Maryland

DANIEL, Isaac M.  
IIT Research Institute  
Chicago, Illinois

DAVIS, Andrew W.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

DECKER, Raymond F.  
International Nickel Company  
Sterling Park, New York

DIEFENDORF, Russell J.  
Rensselaer Polytechnic Institute  
Troy, New York

DOW, Norris F.  
General Electric Company  
Valley Forge, Pennsylvania

ELLIOTT, Steven Y.  
McDonnell Douglas Corporation  
Huntington Beach, California

FLOREEN, Stephen  
International Nickel Company  
Sterling Park, New York

Expertise

Fatigue failure mechanisms in composite materials. Stress analysis of composites. Predicting fatigue failure with damage indicators. Static and dynamic photoelasticity.

Strength of composite materials under mechanical and thermal fatigue. Stress concentration and strength reduction in composites. Experimental mechanics of composites.

Life prediction of composite materials. Structural reliability. Fatigue. Fracture mechanics of composite materials.

Composites. Mechanisms of nickel-based superalloys. High temperature effects.

Fracture of high performance fibers. Effects of structure on fracture of composites. Interfacial bonding. Stability of fibers. Torsional fatigue.

Composite materials data on low cycle and thermal fatigue. Composite structural analysis.

Composite materials. Life prediction of metallic and adhesive bonded composite structures. Structural design and analysis. Testing.

Laminar composites. Environmental effects. Material properties. High temperature metallurgy. Nickel-base alloys. High strength steels.

Expert

Organization

FREESTON, W. Denny, Jr.  
Georgia Institute of Technology  
Atlanta, Georgia

GARMONG, Gregory O.  
Rockwell International, Inc.  
Thousand Oaks, California

GRIMES, Glenn C.  
Southwest Research Institute  
San Antonio, Texas

HALPIN, John C.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

HANCOCK, James R.  
H. C. Price Company  
Bartlesville, Oklahoma

HELLER, Robert A.  
Virginia Polytechnic Institute  
and State University  
Blacksburg, Virginia

HERTZBERG, Richard W.  
Lehigh University  
Bethlehem, Pennsylvania

HOLLENBERG, Glenn W.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

Expertise

Composite materials. Mechanics  
of flexible fibrous structures.  
Fabric flammability.

Composite materials. Mechanical  
properties. Plasticity. Solidification.

Composite materials. Environmental  
effects. Fracture mechanics analysis.

Fibrous composites. Structural  
applications. Static strength.  
Environmental effects. Structural  
analysis.

Fatigue and fracture of metals and  
composite materials. Fracture toughness  
testing. Electron microscopy of metals  
and composites. Interface design for  
composites.

Composite material data. Fatigue  
under varying embrittlement conditions.  
Creep effects.

Microstructural aspects of fatigue crack  
propagation in metal alloys and polymers.  
Mechanical response of unidirectional,  
solidified eutectic composites.  
Electron fractography. Failure analysis.  
Deformation and fracture of materials.  
Fracture mechanics analysis.

Failure/fracture of carbon/carbon  
composites. Fracture behavior of  
graphite materials and microcracked  
ceramics. Creep of ceramics.

Expert

Organization

HOWELL, William E.  
NASA Langley Research Center  
Hampton, Virginia

JACOBSON, Marcus J.  
Northrop Corporation  
Hawthorne, California

JOHNS, Robert H.  
NASA Lewis Research Center  
Cleveland, Ohio

KAMINSKI, Ben E.  
General Dynamics Corporation  
Fort Worth, Texas

KREIDER, Kenneth G.  
National Bureau of Standards  
Washington, D. C.

KROCK, Richard H.  
P. R. Mallory and Company, Inc.  
Burlington, Massachusetts

LYTTON, Jack L.  
Virginia Polytechnic Institute  
and State University  
Blacksburg, Virginia

McGARRY, Frederick  
Massachusetts Institute of  
Technology  
Cambridge, Massachusetts

OUTWATER, John O.  
University of Vermont  
Burlington, Vermont

Expertise

Composite materials. Data on low cycle and thermal fatigue.

Fiber reinforced composites. Honeycomb structures. Vibration effects. Thermal effects. Acoustic fatigue. Fracture mechanics analysis.

Structural characteristics, metal- and resin-matrix composites. Composite structural analysis.

Fracture of composite materials. Fracture toughness testing. Strength of materials. Applications theory. Design criteria.

Fatigue and fracture of metal matrix composites. Fabrication methods. Analysis techniques. Diffusion and kinetics of materials.

Composite materials data on low cycle and thermal fatigue. Refractory metals. Beryllium- and copper-base alloys.

Fracture characteristics of fiber-reinforced composites. Hydrogen embrittlement of superalloys. Mechanisms of failure of steel.

Mechanics of fracture. Mechanisms of fracture. Composite materials.

Polymers, metals, ceramics, and composite materials. Fatigue. Test methods. Fracture mechanics analysis.

Expert

Organization

PAGANO, Nicholas J.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

PETRASEK, Donald W.  
NASA Lewis Research Center  
Cleveland, Ohio

PIPES, R. Byran  
University of Delaware  
Newark, Delaware

RAO, P. Nagaraja  
IIT Research Institute  
Chicago, Illinois

REIFSNIDER, Kenneth L.  
Virginia Polytechnic Institute  
and State University

ROSEN, B. Walter  
Materials Science Corporation  
Blue Bell, Pennsylvania

SALKIND, Michael J.  
United Aircraft Corporation  
East Hartford, Connecticut

SIGNORELLI, Robert A.  
NASA Lewis Research Center  
Cleveland, Ohio

Expertise

Fatigue in composites. Influence of interlaminar stresses on delamination under static and cyclic loading.

Wire reinforced composites. Metal matrix composites. Mechanical characteristics of refractory metal wires.

Composite materials. Fiber-reinforced laminates. Stress analysis. Moire analysis.

Fatigue mechanisms of reinforced composites. Aircraft structures.

Composite material data on low cycle fatigue. Thermal effects near stress concentrations. Elastic-plastic fatigue crack propagation.

Composite materials. Structural design. Mechanics and strength. Thermal effects. Structural analysis.

Fiber reinforced materials. Controlled solidification. Powder metallurgy. Sintering.

Wire reinforced composites. Metal matrix composites. Mechanical characteristics of refractory metal wires.

Expert

Organization

STEELE, James H., Jr.  
Virginia Polytechnic Institute  
and State University  
Blacksburg, Virginia

STUHRKE, William F.  
Martin Marietta Corporation  
Orlando, Florida

SULLIVAN, Timothy L.  
NASA Lewis Research Center  
Cleveland, Ohio

TENNEY, Darrell R.  
NASA Langley Research Center  
Hampton, Virginia

TOTH, Istvan J.  
TRW, Inc.  
Cleveland, Ohio

TSAI, Stephen W.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

UNDERWOOD, John H.  
Benet Weapons Laboratory  
Watervliet, New York

WHITNEY, James M.  
Air Force Materials Laboratory  
Wright-Patterson AFB, Ohio

WRIGHT, Maurice A.  
University of Tennessee Space  
Institute  
Tullahoma, Tennessee

Expertise

Fracture characteristics of fiber-reinforced composites.

Fiber-reinforced composites.  
Metal matrix composites. Fatigue and fracture testing. Interaction effects.

Multiaxial composites. Crack propagation. Measurement of crack growth.

Analysis of metallic diffusion in fiber-reinforced composite materials.

Aluminum and titanium matrix composite. Fatigue and fracture of metal matrix composites. Composite failure analysis.

Mechanics of composite materials. Structural applications of composites. Elasticity. Aircraft structures.

Composite materials. Fracture. Fracture toughness testing. Crack tip deformation.

Fracture and fatigue analysis in fiber-reinforced non-metallic matrix composites. Effect of stress concentration. Life predictions. Environmental effects.

Effects of thermal cycling and loading on boron-aluminum composites. Linear elastic fracture mechanics analysis of composite materials. Fatigue properties of fiber-reinforced plastic-matrix structural materials.

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